

different forms of mirage, whether due to reflection from above or below, or from the side, is essentially that given by Tait in his paper "On Mirage" in the *Edinburgh Transactions*. Of the "Fata Morgana," two specially interesting examples are cited from observations by Prof. Boccara in 1900 and 1901, while of distortion due to abnormal atmospheric refraction the most striking cases are those seen by Arctowski, as quoted from the records of the Belgian Antarctic Expedition.

The theory of the scintillation of the stars and planets, and of the analogous phenomena observed in the sun and moon when almost eclipsed, has aroused an exceptional amount of attention, and is here very fully considered. Lord Rayleigh has discussed the matter in a paper on the theory of stellar scintillation, where the failure of the "interference" theory as propounded by Arago is made clear. The various optical effects in which the phenomenon may be said to consist, the quivering and the fluctuations in intensity and colour, as well as the meteorological conditions, the extent and character of the atmospheric "striae," with the best methods of observation and measurement, are most completely dealt with in the papers by Karl Exner in the *Sitzungsberichte* of the Vienna Academy of Sciences and elsewhere. Prof. Pernter accepts what he designates the Montigny-Exner theory as giving a complete and exact explanation of the whole phenomenon.

The theory of halos, of parhelia and anthelia, and allied phenomena given in the third section of the book is founded on the classical work of Bravais "Sur les Halos," which dates from the middle of last century. Though Prof. Pernter speaks of this theory, elaborated by Galle and Bravais, as giving an entirely satisfactory and in all main essentials complete explanation of the phenomena, he is yet able, with the greater mass of more exact records of observations at his command, and the more accurate knowledge as to the form and optical characteristics of ice-crystals—six plates of reproductions of photographs of various types of ice-crystals are given—to confirm or correct in many details the earlier theory. The rarity of some of the appearances necessarily renders numerical confirmation difficult, and it may be well to note, for example, the desirability of further careful observations of the "schiefe Bögen von Löwitz," the lateral arcs tangential to the halo of 22° ; and of the parhelia related to the halo of 46° , especially the colour effects when the sun is in the horizon. The whole discussion is fully and clearly given, and is very suggestive of the possibilities of further meteorological research.

The author next deals with the phenomena due to diffraction effects, whether seen directly by transmitted light or by reflection—coronæ, the "Glory" or "Brockengespenst," iridescence of the clouds, &c.—with an exposition of the theory as developed by Fraunhofer, Verdet, and Exner, and based on Airy's development of an expression for the variation in light intensity in the diffraction image. The volume concludes with a complete discussion of the rainbow. Prof. Pernter follows the theory of

Descartes to the point where its neglect of the consequences of diffraction leaves it inadequate to explain the phenomena, basing his subsequent development on the Airy "rainbow-integral" for the intensity of light in the neighbourhood of a caustic.

Prof. Pernter suggests that, in a subject of which so much has been written in monograph, his work must necessarily be of the nature of a compilation. He expresses the hope, however, that it may perhaps claim to be more than a mere compilation. No one who has read his work with any attention will be likely to question this claim. Rather it may be taken as the model of what a standard treatise on a branch of physical science should be, written by one whose researches have done very much to remove difficulties and to lighten obscurities. Dealing as it does with matters of absorbing interest, it is unquestionably a book to be read by everyone who takes an interest in the study of natural phenomena.

THE NEW EVOLUTION.

Recent Progress in the Study of Variation, Heredity and Evolution. By R. H. Lock. Pp. xv+299. (London: John Murray, 1906.) Price 7s. 6d. net.

THE labours of a new school of biologists, ably represented in this country by a band of energetic workers at Cambridge of whom the author of the present book is not the least distinguished, have been of great service both direct and indirect to the study of evolutionary method. It was perhaps to be expected that in the first flush of enthusiasm caused by the re-discovery of an important generalisation like Mendel's, judgments should be formed and statements made some of which may seem to pass the bounds of scientific caution; but signs are not wanting that a more restrained attitude is beginning to prevail, and it is a healthy symptom that the free use of the experimental method, rather than mere academic discussion, characterises the work of the new evolutionists.

A noteworthy point in the biological movement of the day is the response that is being given in various quarters to the reasonable demand for quantitative treatment of the facts of variation, selection and heredity. From the side both of the biometricians and of the Mendelians, statistical evidence is being accumulated and dealt with on a scale that might have satisfied Stanley Jevons himself. It must be confessed that the pretensions of these two schools are at present more or less antagonistic to each other and to the convictions of orthodox Darwinians; it is certain, however, that the questions raised in the course of this three-cornered rivalry are of the greatest importance, and that nothing but good can come of their thorough discussion.

The book before us gives an elementary but generally clear and skilful exposition of the present aspects of the evolutionary problem. It is the work of one whose sympathies are confessedly Mendelian and mutationist, but who shows a real desire to do justice to the views of opponents. Mr. Lock's point of view is far removed from that of certain half-

instructed writers in the lay Press, according to whom natural selection is nothing but a discarded fashion of the mid-Victorian period, as obsolete to-day as the pork-pie hat and the crinoline. But he is none the less a disbeliever in the Darwinian account of the origin of species.

High as are the merits of Mr. Lock as an expositor, there are points, as we think, on which his arguments must fail to carry conviction. The phenomena of adaptation we hold to be of supreme importance in the interpretation of evolutionary process. It is difficult to exaggerate the extent to which adjustment to the circumstances of life prevails in every department of organised nature. This is a fact which the advocates of "mutation" do not fairly face. Mr. Lock is too candid not to admit that "organic beings on the whole are, as a general rule, very closely fitted for the conditions in which they have to pass their lives." But after adducing certain well-known instances of "animals having peculiar habits, and possessing at the same time special organs which render them well fitted for these habits and no others," he manages to convey the impression that such cases are not very common, and that, considered as evidence of the power of natural selection, the best of them are open to criticism. Then, after a sketch of the theories of mimicry and protective resemblance, he adds that it is "uncertain whether this principle [of natural selection] can hold good as the true description of the origin of any sort of resemblance."

"Perhaps a still more serious criticism," he goes on to say, "of the methods of those who spend their time in seeking out or devising cases of adaptation has been made by Bateson, who points out the logical difficulty that we can never make any quantitative estimate of the amount of benefit or the reverse which any particular structure may afford to its possessor." Most biologists will allow that quantitative methods should be used wherever possible for the solution of the problem, and it is curious that Mr. Lock should apparently not be aware that there are several instances in which this has been done. We do not see where the "logical difficulty" lies; on the question of fact we regret to differ from Mr. Bateson, if his opinion is here correctly stated.

The underlying idea in all that Mr. Lock has to say on the subject of adaptation by selection is the doctrine that specific differences arise by way of "mutation," or *de novo*, and not by the accumulation of continuous or "fluctuating" variations. The position is ably argued, and the results of the laborious experiments of de Vries and of the remarkable work of Johannsen are brought to bear with the skilful touch of a genuine investigator who is personally conversant with the matter in hand; nor does Mr. Lock's general attribute of fairness here desert him. A point, however, on which we should like to be satisfied is this: the author asserts that "no one questions the validity of natural selection as a means of exterminating types which are unfitted for their environment"; further, he thinks it at least probable that certain types have survived in conse-

quence of their "fitness." But, since these latter types arose, as he would say, suddenly or discontinuously, how did it happen that they sprang into being in such exact harmony with their surroundings? Would Mr. Lock have us fall back upon the theory of "directed variation," or, what comes to the same thing, Paley's view of "contrivance" by special creation? If it be replied that a well-adapted type must have arisen, not by one or more large mutations, but by a series of mutations both numerous and minute, we should wish to know how such mutations are to be distinguished from continuous variations. To say, with de Vries, that selection of individual differences is powerless to raise permanently the mean of a species, seems perilously like begging the question. As soon as the mean had been permanently raised, the result would be claimed as a mutation.

We have space only for one further remark. If Mr. Lock will take his Aristotle again, and read, with its context, the passage he has quoted on p. 116, we think he will see that he has mistaken that philosopher's meaning, as, indeed, Darwin did before him.

F. A. D.

NOTES ON WATER PLANTS.

Biologische und morphologische Untersuchungen über Wasser- und Sumpfgewächse. Part ii. By Prof. Hugo Glück. Pp. xvii+256. (Jena: Gustav Fischer, 1906.) Price 18 marks.

THIS work forms the second instalment of the author's studies on water plants. It deals chiefly with the European species and varieties of *Utricularia*, and, as was perhaps inevitable, one result has been to increase the number of the forms hitherto recognised as distinct. A prominent feature of the book lies in the attention devoted to the so-called *Turions*, or propagation buds, which occur so frequently in aquatic phanerogams.

Several other aquatic genera also are dealt with, e.g. *Ceratophyllum*, in which Prof. Glück finds a specialised form of shoot provided with anchoring leaves, much reduced in character, which serve to fix the plant in the mud. These leaves differ from the ordinary foliage leaves in the absence of chlorophyll and in the almost complete suppression of the intercellular spaces so characteristic of the latter.

The conclusions reached as to the morphological interpretation to be placed on the different parts of the *Utricularia* plants do not essentially differ from those drawn by Goebel about sixteen years ago as the result of an extensive series of investigations on tropical as well as on European species of this remarkable genus. The special feature of interest attaching to them lies in the impossibility of establishing a consistent distinction between the stem and leaf in these plants. One can pass into or be replaced by the other in the most irregular manner, and either of them may in turn be represented in position by one of the bladders that form so characteristic a feature of the genus. As Prof. Glück remarks, the